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**13. ABSTRACT** *(Maximum 200 Words)*
Preliminary studies needed to develop and deploy a domain-independent computational framework for the interactive, collaborative design and manufacture of multifunctional materials in a distributed product realization environment were performed. The framework supports systems-based material design initiatives including an on-going AFOSR MURI (AFOSR 1606U81) and can also be used to support projects within the AFOSR MEANS program. The following tasks were completed: (i) A domain-independent computational framework was developed and demonstrated for multi-functional heat exchangers. (ii) Simulation models and databases developed by the MURI team were deployed so that they can be accessed remotely over the web. (iii) A STEP standard based database for capturing design information for Linear Cellular Alloys was developed (iv) An overview/video of real-time, distributed, simulation-based design was presented at the AFOSR Workshop 8/8/2003 in Boulder, Colorado. (v) The basic architecture of digital interfaces to support different perspectives of the stakeholders in a design process was developed and methods for facilitating collaboration were developed. (vi) A web-server to support collaboration within our MURI http://www.afosrmuri.gatech.edu/ was developed. This includes information about people, presentations, publications, the X-DPR software and a web-board with permission control

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Final Report

For Project: F49620-03-1-0348

An Interactive, Distributed, Computational Environment
for the Design of Multi-Functional Materials and Processes

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July 15, 2004

Preliminary studies needed to develop and deploy a domain-independent computational framework for the interactive, collaborative design and manufacture of multifunctional materials in a distributed product realization environment were preformed. The framework has been used to support systems-based material design initiatives, including an on-going AFOSR MURI (AFOSR 1606U81) a project for designing nano-structured energetic materials. Such a framework can be also be used to support the design efforts inherent in other projects within the AFOSR MEANS program. The following tasks were completed:

(i)   A domain-independent computational framework and demonstrated its use for multi-functional heat exchangers, hence demonstrating simulation-based design at the continuum scale was developed. In this work, computational methods existing within the Systems Realization Laboratory were used and all demonstrations were carried out in the context of the design of a linear cellular-alloy heat exchanger.

(ii)  A real-time simulation of distributed, simulation-based design was presented at the AFOSR Workshop on August 8, 2003 in Boulder Colorado. This included the web-integration of heterogeneous software resources and the active integration of iSIGHT and augmentations through improved meta-modeling techniques. The presentation and movie are available at http://www.afosrmuri.gatech.edu/phpBB2/viewtopic.php?t=80. (Passwords are needed to download the information.)

(iii) The basic architecture for digital interfaces to support different perspectives of the stakeholders in a design process was developed was developed and methods for facilitating future interactions and collaboration in a structured way were formulated.

(iv)  A web-server to support collaboration within our MURI http://www.afosrmuri.gatech.edu/ was deployed. This includes information about people, presentations, publications and the X-DPR software. A web-board to encourage collaboration was set up with appropriate permission control.

(v)   A STEP standard based database for capturing design information for Linear Cellular Alloys was developed.

(vi)  Simulation models and databases developed by the AFOSR MURI team were deployed on the MURI server so that they can be accessed by others remotely over the web. The simulation models were integrated with the ModelCenter application in order to perform design space exploration and synthesis.

Our work points to the need for further development of techniques for facilitating and managing collaboration, including the development of digital interfaces and methods for capturing, archiving and retrieving information, especially as it relates to design processes.

Publications:

1. Panchal, J.H., M.G. Fernandez, C.J.J. Paredis, J.K. Allen, and F. Mistree, "Role of Designing Design Processes in Product Life Cycle Management" ASME Computers and Information in Engineering Conference, Salt Lake City, Utah[1]. DETC2004/CIE57742.

2. Panchal, J.H., Fernández, M.G., Paredis, C.J.J., and Mistree, F., 2004 "Reusable Design Processes via Modular, Executable, Decision-Centric Templates," *AIAA/ISSMO Symposium on Multidisciplinary Analysis and Optimization,* Albany, NY. Paper Number: AIAA-2004-4601 (Accepted, to be presented.)

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[1] Under consideration for Best Paper.